Fiber Tolerances

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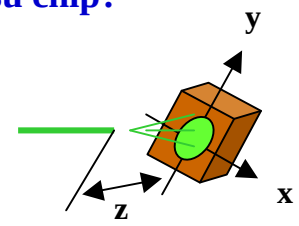
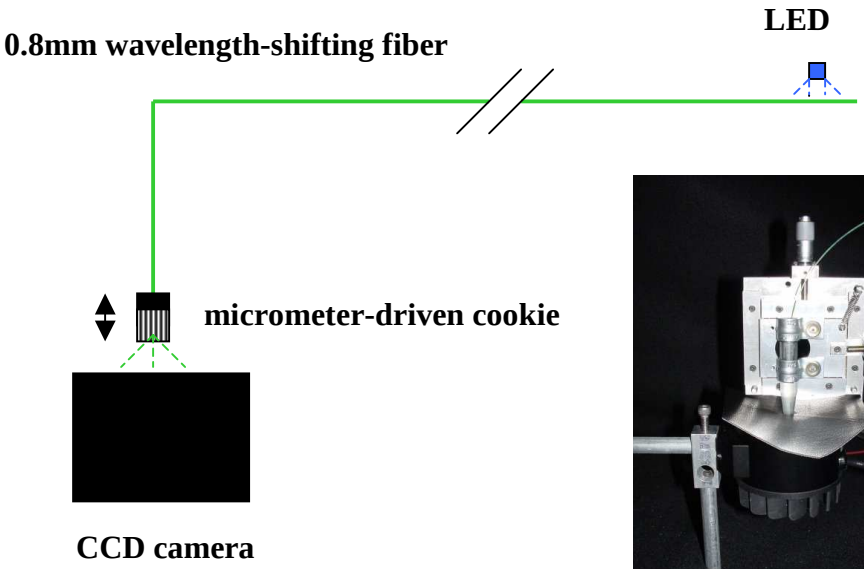
X/Y Tolerance vs Fiber Height

Issue: What are the x/y alignment tolerances required for an APD pixel as a function of fiber height (z) above the chip?

- **in particular, are alignment issues a show-stopper for the current Hamamatsu chip?**



Apparatus



X/Y Tolerance vs Fiber Height

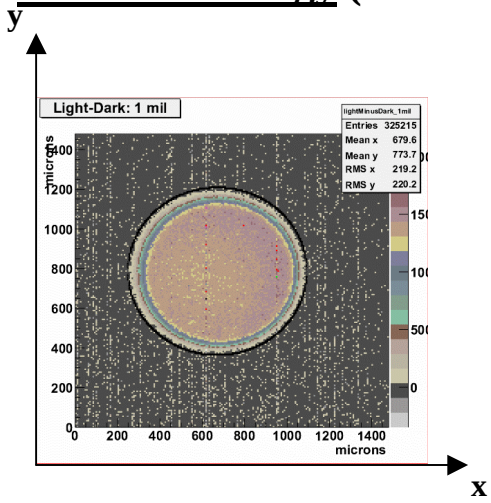
Measurement Sequence:
- **dark**
- **light, 1-5 mils**
- **dark**
- **light, 1-5 mils**
- **dark**

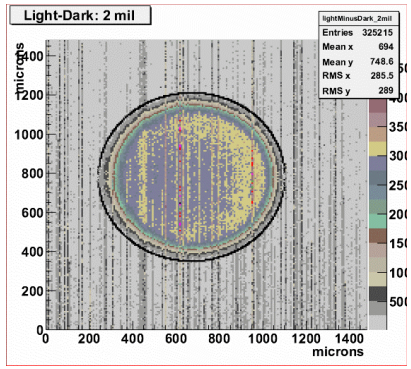
Analysis:
- **image –**
  (Mean Light – Mean Dark)

- **encircled energy –**
  eyeball estimate

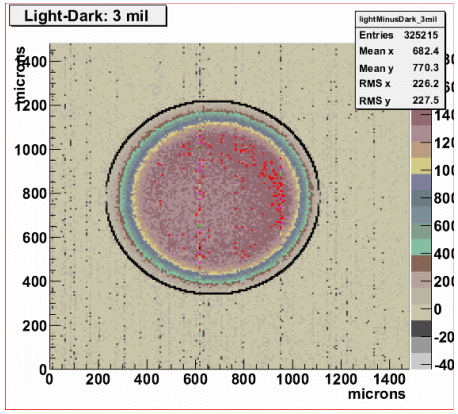
Fiber Irradiance Patterns on CCD + Encircled Energy (solid black circle) – *eyeball estimate*

z = 1 mil

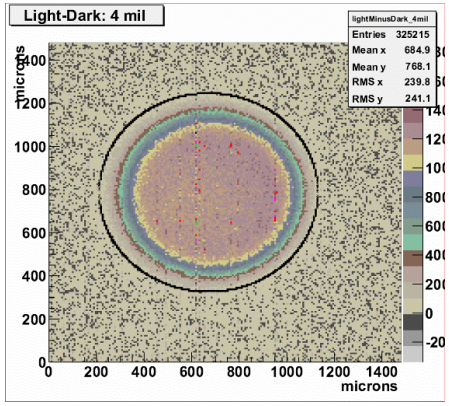




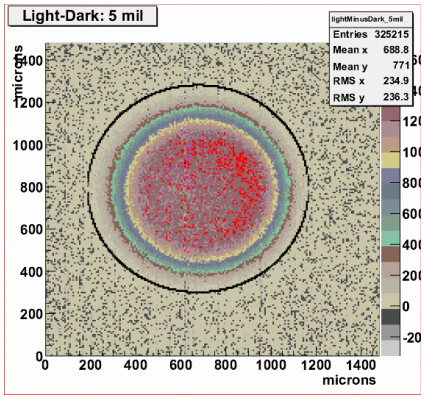
z = 2 mil



z = 3 mil

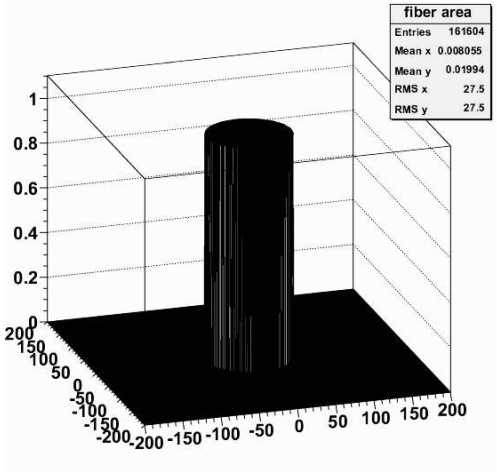


z = 4 mil



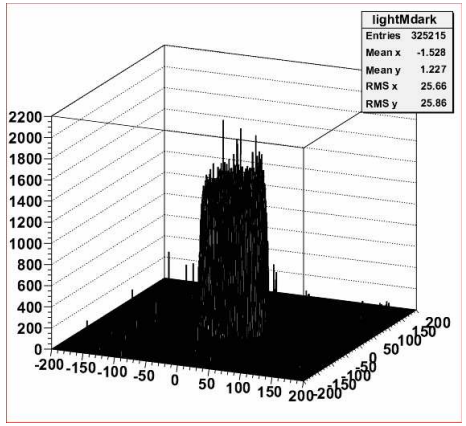
z = 5 mil

Encircled Energy, More Precise Computation



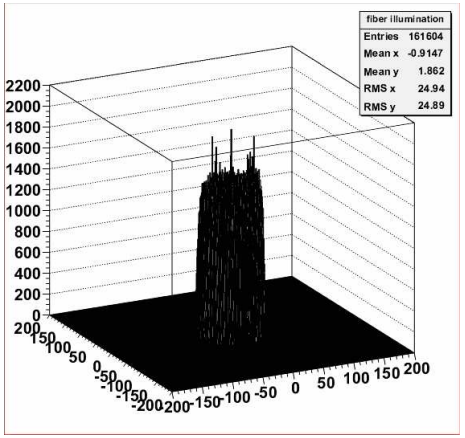
normalized fiber pattern, z = 1 mil

X



measured light pattern, z = 1 mil

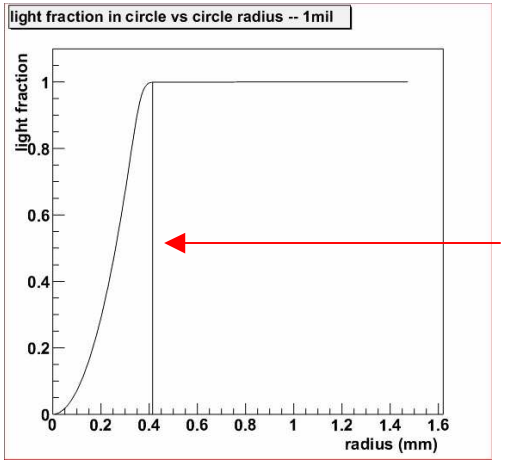
=



irradiance pattern on chip @ z = 1 mil

Integrate over current chip geometry

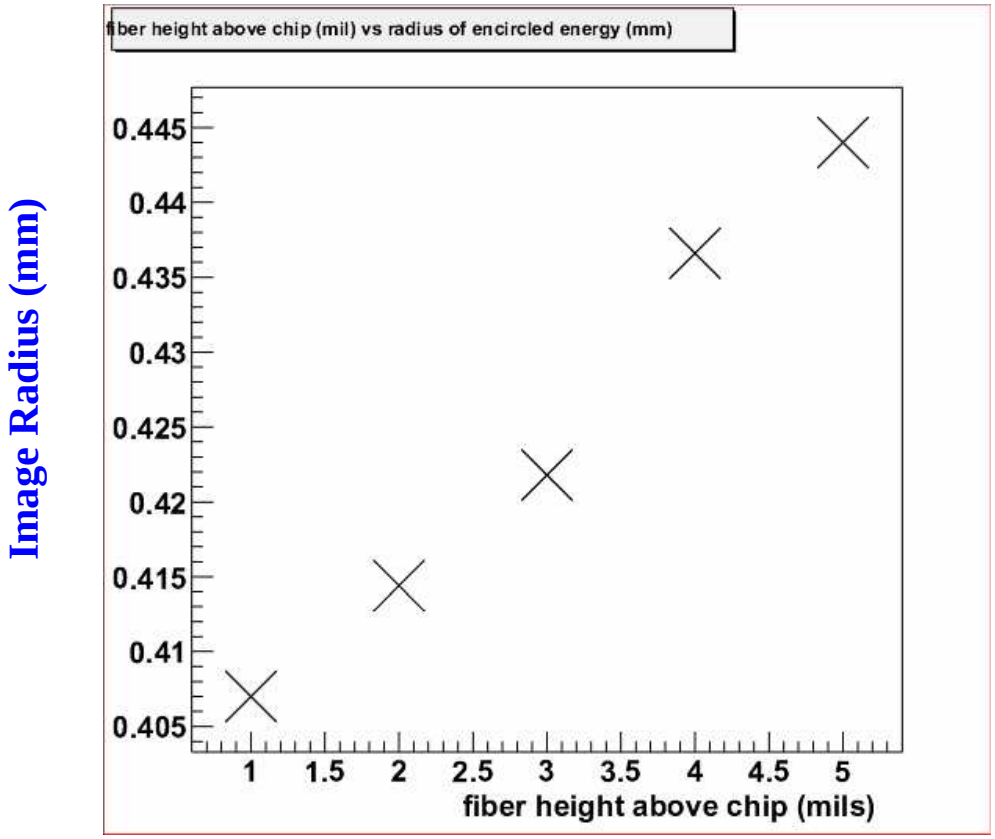
fraction of light encircled



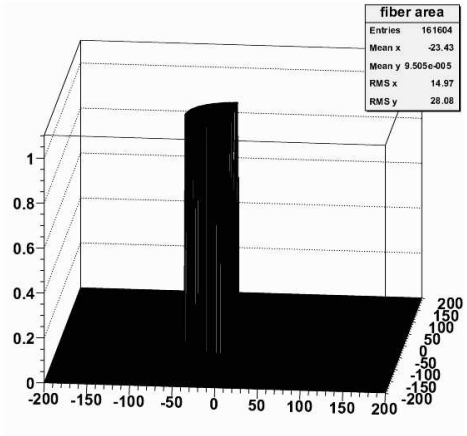
radius of encircled energy (microns)

radius at which 0.999% of light is encircled
z = 1 mil

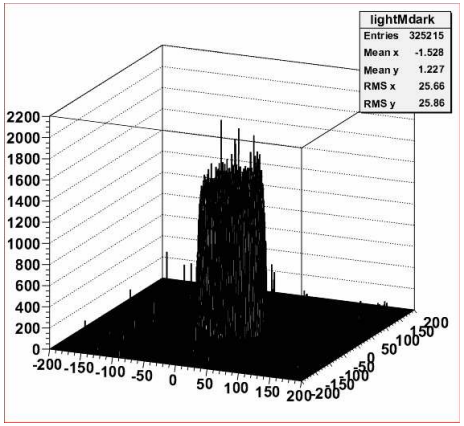
Image Radius vs. Z



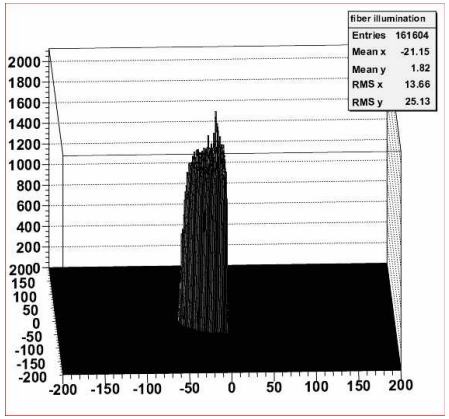
Estimate of X/Y Tolerance vs Fiber Height



normalized fiber pattern, z = 2 mil, displaced to pixel edge

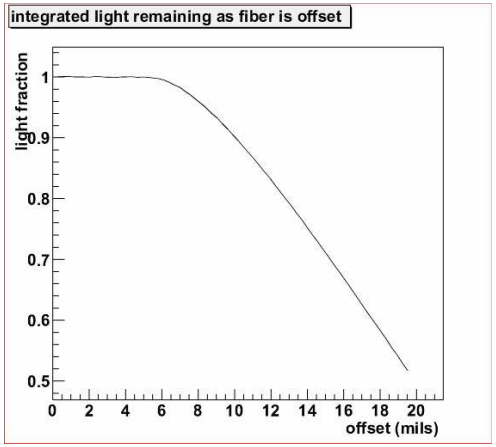


measured light pattern, z = 2 mil



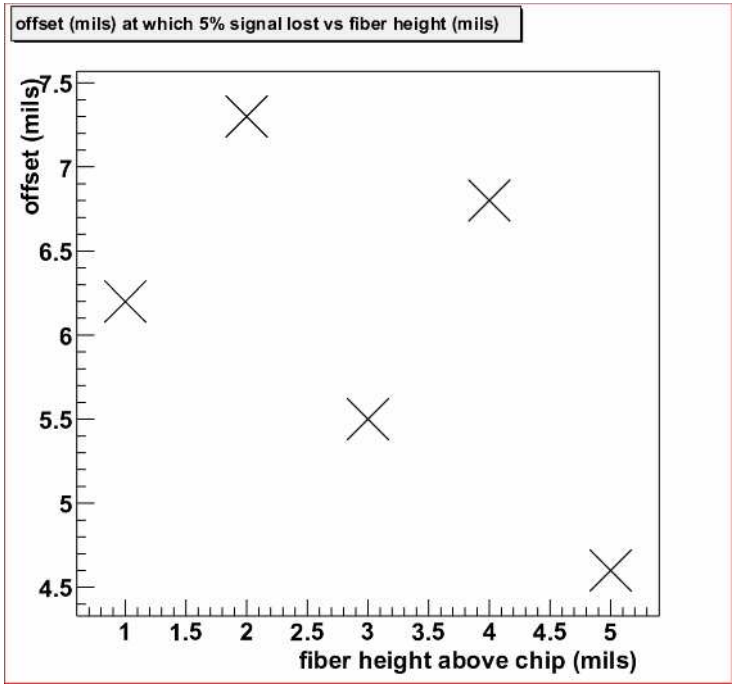
irradiance pattern on chip @ z = 2 mil

Integrate over current chip geometry



light fraction remaining as fiber is offset
z = 1 mil

Offset at which 5% of light is lost vs Fiber Height



Tolerance Computation:

- **Find Δx/Δy offset at which 5% of signal is lost on APD pixel as a function of fiber height above APD chip**

Preliminary